RESTORATION WORKS AT CHHATRAPATI SHIVAJI MAHARAJ VASTU SANGRAHALAYA

Completion Report for Phase I Exterior Restoration Works

Architects

Abha Narain Lambah Associates: Conservation Architects & Historic Building Consultants

Structural Rehab Consultant

Mr. Arup Sarbadhikary

Contractors

Ravi Gundurao & Associates

Acknowledgements

Our sincere acknowledgements to Mr. Sabyasachi Mukherjee, Director Chhatrapati Shivaji Maharaj Vastu Sangrahalaya and the Trustees of the Museum for giving us an opportunity to work on this monumental structure. We are grateful to the staff of the CSMVS for bearing with all the demands of the project.

Our sincere thanks to the MMR-HCS and the trustees for the grant of Rs. 25 lacs in support of the Restoration Works for the CSMVS. (Formerly Prince of Wales Museum)

We are grateful to the support of Mr. Arup Sarbadhikary through this entire project as the structural advisor and consultant.

We acknowledge the dedication of Mr. Ravi Gundurao and his team including Ms. Kumkum Devi and Mr. Swamy on the project.

Abha Narain Lambah Associates acknowledge the support of its in house architectural team, project architect Ms. Kruti Garg and support team of architects who worked on this project.

Abha Narain Lambah

December 2008

HISTORIC BUILT FABRIC

The Chhatrapati Shivaji Maharaj Vastu Sangrahalaya, formerly known as the Prince of Wales Museum is one of the finest specimens of Indo Saracenic architecture of British India representative of colonial buildings in the early decades of the 20th Century.

The foundation stone for the structure was laid by the Prince of Wales on his visit to Bombay in 1905.

Designed by the famous architect George Wittet, the building was completed in 1914 but the Museum was only opened to the public on the 10th of January, 1922.

An eclectic composition of Indian Islamic elements with a symmetrical European plan, the Grade I heritage museum building is largely evocative of the medieval Islamic tombs of Bijapur, in sync with the Indo Saracenic genre that relied heavily on Indian prototypes as architectural ornament.

Located within the Fort Heritage Precinct , the Museum is listed as Serial Number 164 by the Heritage Regulations of Greater Bombay 1995 as a Grade 1 heritage building acknowledging it as heritage of national importance.

HISTORIC BUILT FABRIC

Designed in this mock Indo-Islamic architectural vocabulary, the Prince of Wales Museum is a stylized departure from its Victorian Neo Gothic neighbours forming the street edge of Mahatma Gandhi Road.

The entire exterior face is a composition of grey and buff basalt stone,

The arches and exterior facades use a remarkable mastery in the use of colours, with arched voussoirs in alternate bands of grey and buff stone.

The skyline is punctuated by domes and minarets. While the central dome is a large expansive structure heavily influenced by the Gol Gumbaz at Bijapur, the rest of the roofscape is largely consisted of flat terraces punctuated by smaller domes and *guldastas*.

Carved stone brackets blend Rajasthani and Gujarati architectural forms to create a true architectural synthesis.

BACKGROUND OF THE CONSERVATION PROJECT

The Grade 1 Historic Building had started to show signs of distress and deterioration in the form of stone weathering, discolouration, missing details and ornamental features, leakages, and structural distress. and was in need of specilised conservation and restoration.

The tasks that needed to be undertaken included conservation and restoration of the stone facade, removal of hard cement pointing and replacement with lime pointing between the stone joints to allow breathability, restoration of the fenestration and architectural details, structural repair and waterproofing as well as the restoration of its ornamental features.

A Project for External Restoration and Structural Consolidation was thus undertaken as part of a comprehensive Conservation & Restoration exercise by the Museum in the year 2006-07 as Phase I Works aimed at restoring the structural and architectural integrity of this Grade I heritage building.

A team of specialist conservators and skilled craftsmen, masons and stone carvers worked on the restoration of the exterior edifice and architectural detailing of this Grade I heritage building under the supervision of a specialist Conservation Architectural firm.

PROBLEMS TAKEN UP TO BE ADDRESSED

Condition of the Facades

The exterior stone masonry of the Prince of Wales Museum exhibited a range of defects and stone deterioration issues that may be explained as follows:

- **Deterioration of Stone**
  - **Delamination**
  - **Weathering of stone**
  - **Soiling and Discolouration**
  - **Rising Dampness**
- **Missing / Broken Details**
- **Cracks**

Right Above: Photograph showing the front façade of the museum that is prone to sulphate encrustations, soiling and flaking
Right Below: Photographs showing a missing stone finial of a roof level *guldasta* in stone and the broken detail of the jaali

PROBLEMS TAKEN UP TO BE ADDRESSED

- **Deterioration of Pointing**
  - **Loss of pointing**
  - **Hard pointing**
  - **Ribbon pointing**

Top to Bottom: Photographs showing hard ribbon pointing in cement, partially removed hard ribbon pointing to expose the finer joints and plinth level masonry with deteriorated pointing that needs to be repointed in lime mortar.

Far Right: Ugly hard pointing that requires removal

PROBLEMS TAKEN UP TO BE ADDRESSED

- **Biological growth**

Especially prone areas were the higher reaches of turrets and minarets not easily accessible to regular maintenance and also areas of choked waterspouts that trap moisture and particulate matter, creating a thriving ground for biological growth.

The biological growth could lead to widening of stone cracks, develop stains and discolouration of stone masonry and damage the walls, thus they needed to be removed immediately.

Photographs showing *Peepal* plants growing out of masonry joints along sections of deteriorated pointing, specially where there is a source of water leakage close by as a result of choked drainage outlets, leaking rain water down takes or air conditioner units

PROBLEMS TAKEN UP TO BE ADDRESSED

Condition of Doors and windows

- Painted glass panes in the ventilators

- Painted glasses in the jaalis below the windows

- Missing or broken glass pieces.

- Condition of the timber in the frame and shutters not visible due to paint

- Blocked areas and provision of the jaalis and windows, which didn't conform to the original design.

- **Air Conditioning Units**

- Hampered the visual integrity

-Leakage from these units led to dampness and microbiological growth

- Altered the original look of the design and detail of the building.

If unchecked, this could eventually have affected the physical integrity of the building.

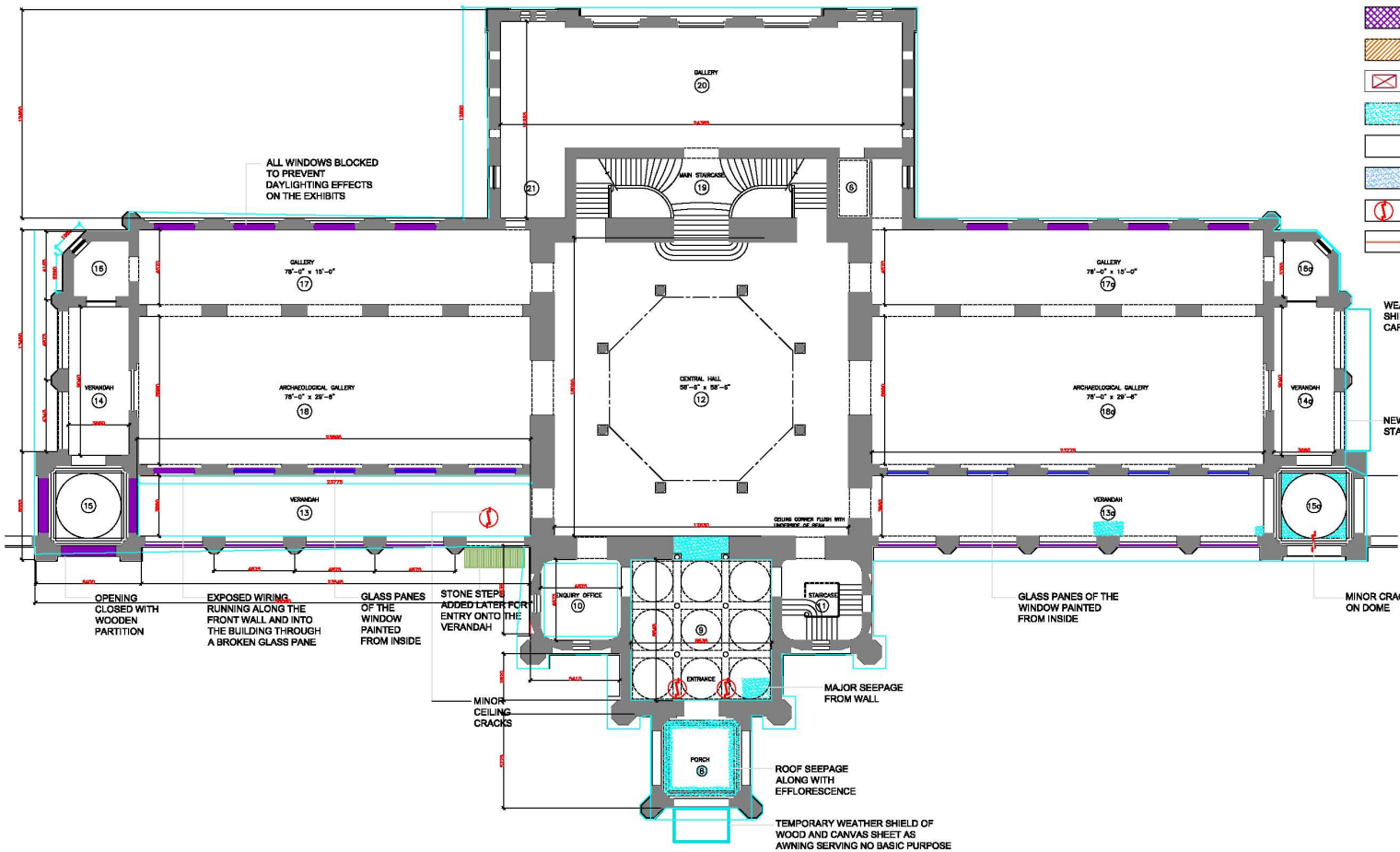
Photograph showing the Deterioration of the window frames
Right: Photograph showing a window air conditioner unit mounted on the sill
Below: Photograph showing the original window design with a glass fanlight and glazed shutters.

PROBLEMS TAKEN UP TO BE ADDRESSED

Condition of terraces & domes

Left and Right Above: Photographs showing the domes surfaces that indicate past grouts as well as patchwork plastering over the surface. Any exercise to undertake major roof repair of the domes should be preceded by thorough non destructive testing and structural investigations.
Right Below: Photograph of the terrace

CONDITION MAPPING DRAWINGS



Principal Conservation Architect
ABHA NARAIN LAMBAH

Project Conservation Architect
KRUTI GARG

Architectural Team
KRISHNA IYER, INDU SATHYENDRAN

Date
NOV . 2006

CONDITION MAPPING DRAWINGS

Client
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Abha Narain Lambah Associates
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GROUND FLOOR PLAN

scale 1 : 250

DRG. NO. 1

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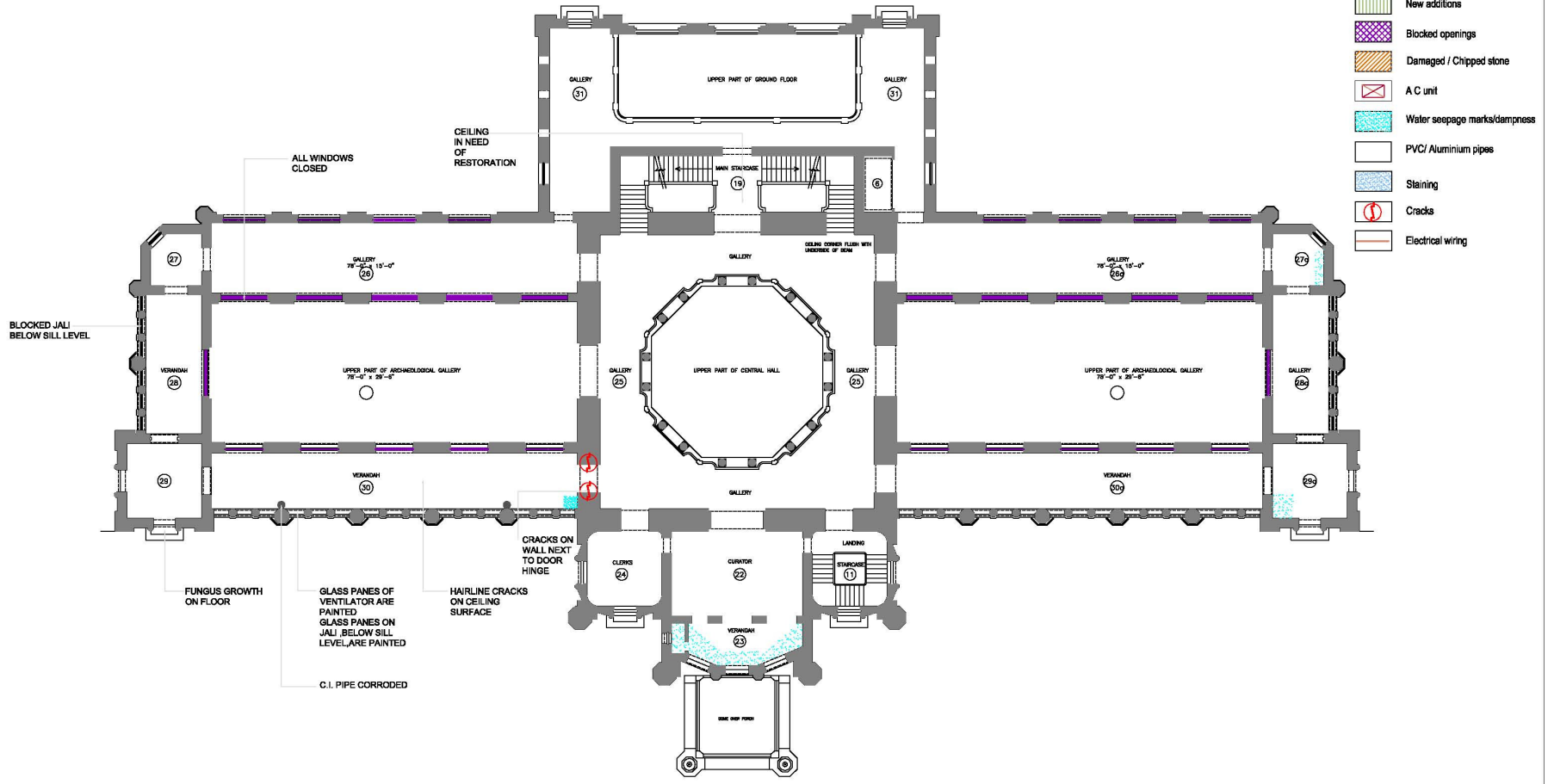
RESTORATION OF CHHATRAPATI SHIVAJI MAHARAJ VASTU SANGRAHALAYA



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FIRST FLOOR PLAN

scale 1 : 250

DRG. NO. 2

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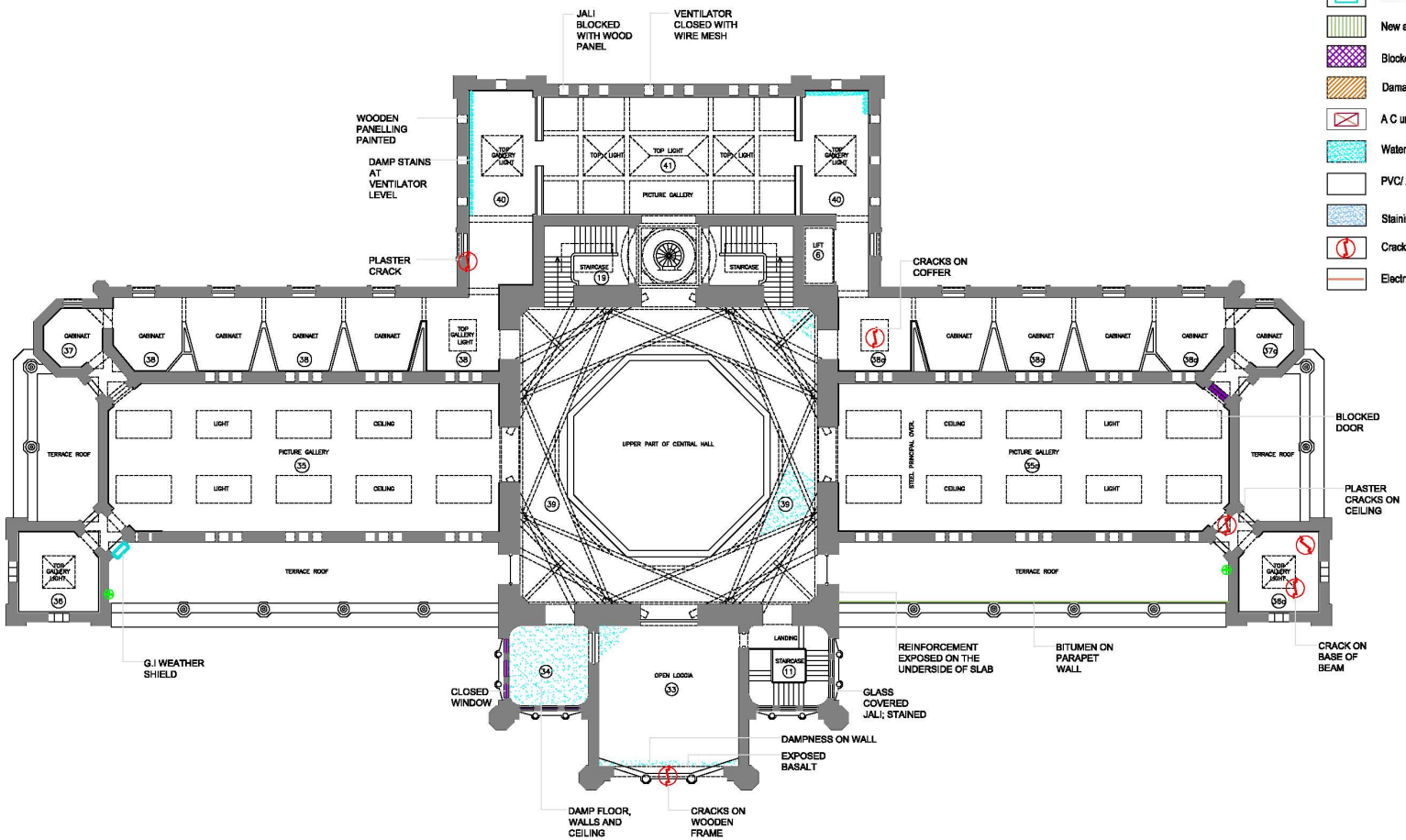

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SECOND FLOOR PLAN

scale 1 : 250

DRG. NO. 3

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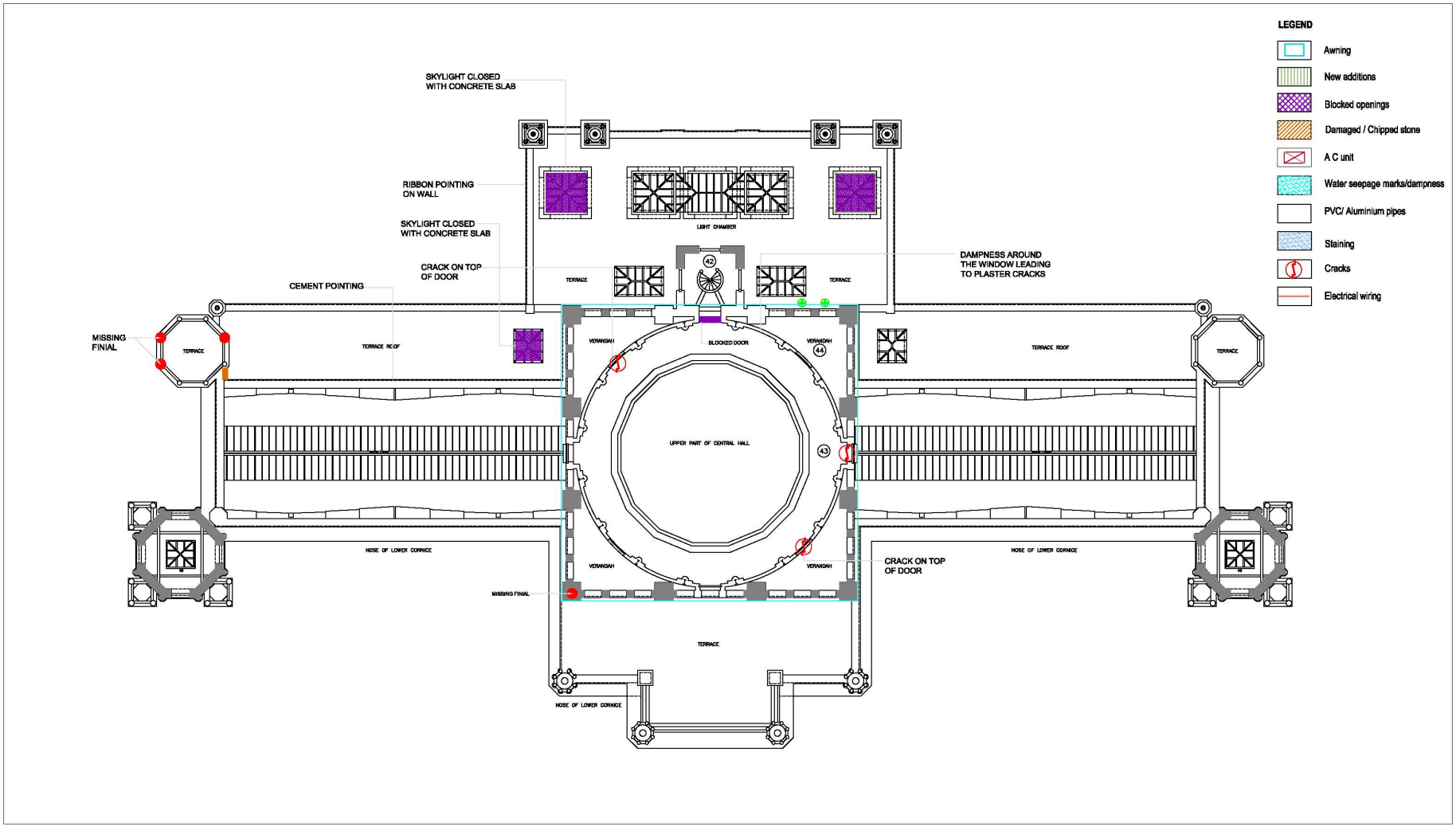
CONDITION MAPPING DRAWINGS



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ROOF PLAN

scale 1 : 250

DRG. NO. 4

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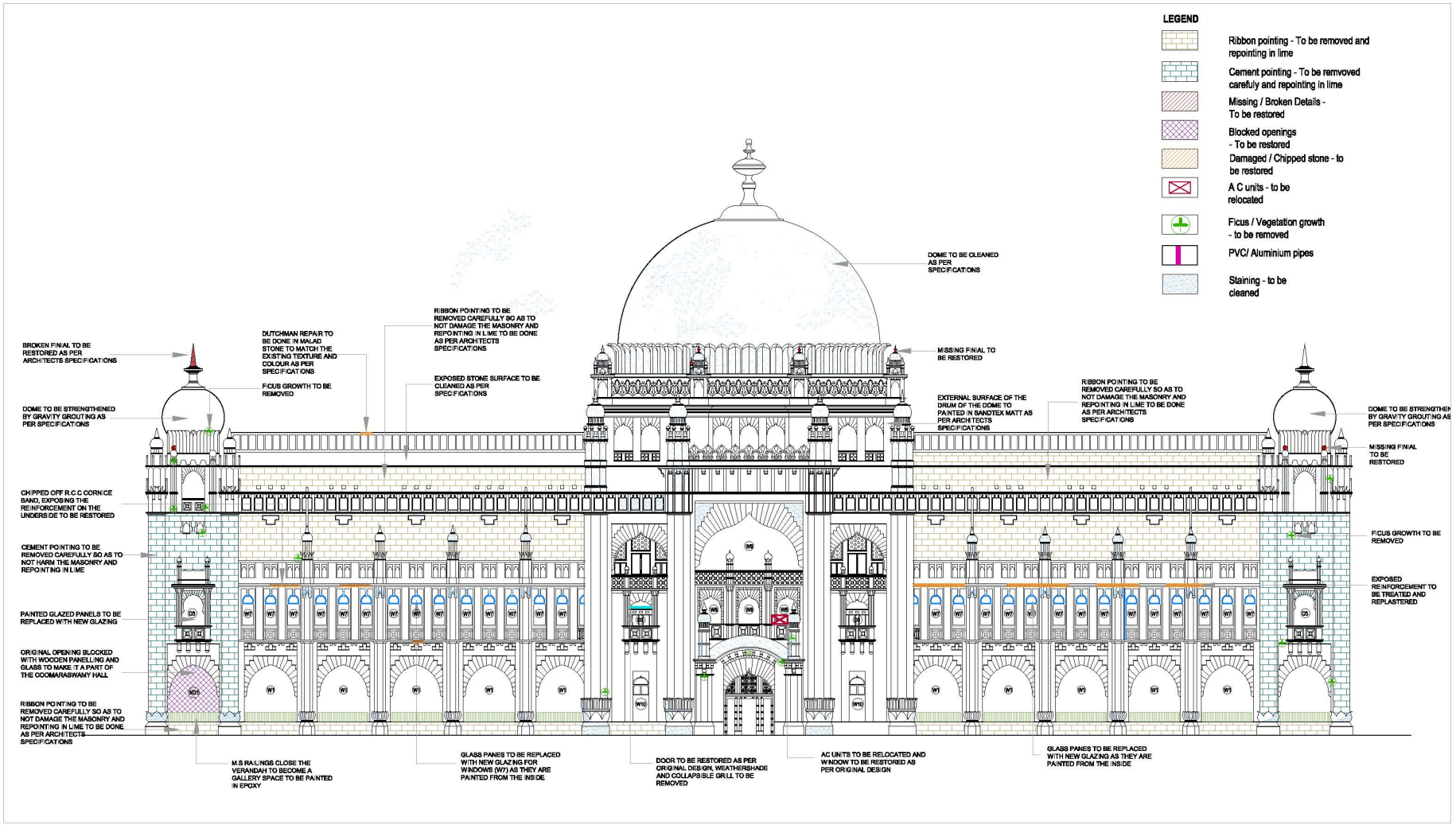
RESTORATION OF CHHATRAPATI SHIVAJI MAHARAJ VASTU SANGRAHALAYA

TENDER DRAWINGS



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FRONT ELEVATION

scale 1 : 250

DRG. NO. 6

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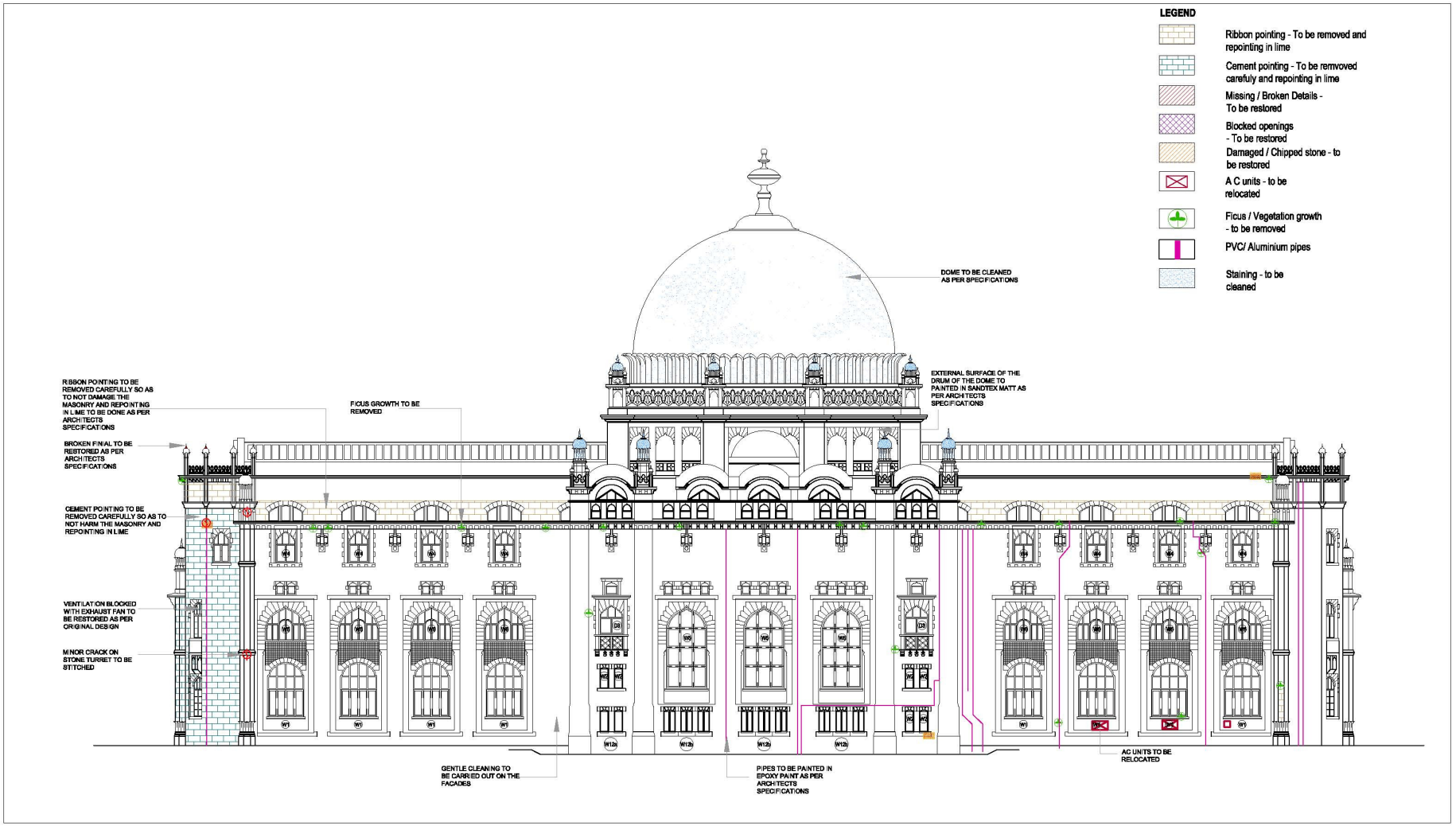

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REAR ELEVATION

scale 1 : 250

DRG. NO. 7

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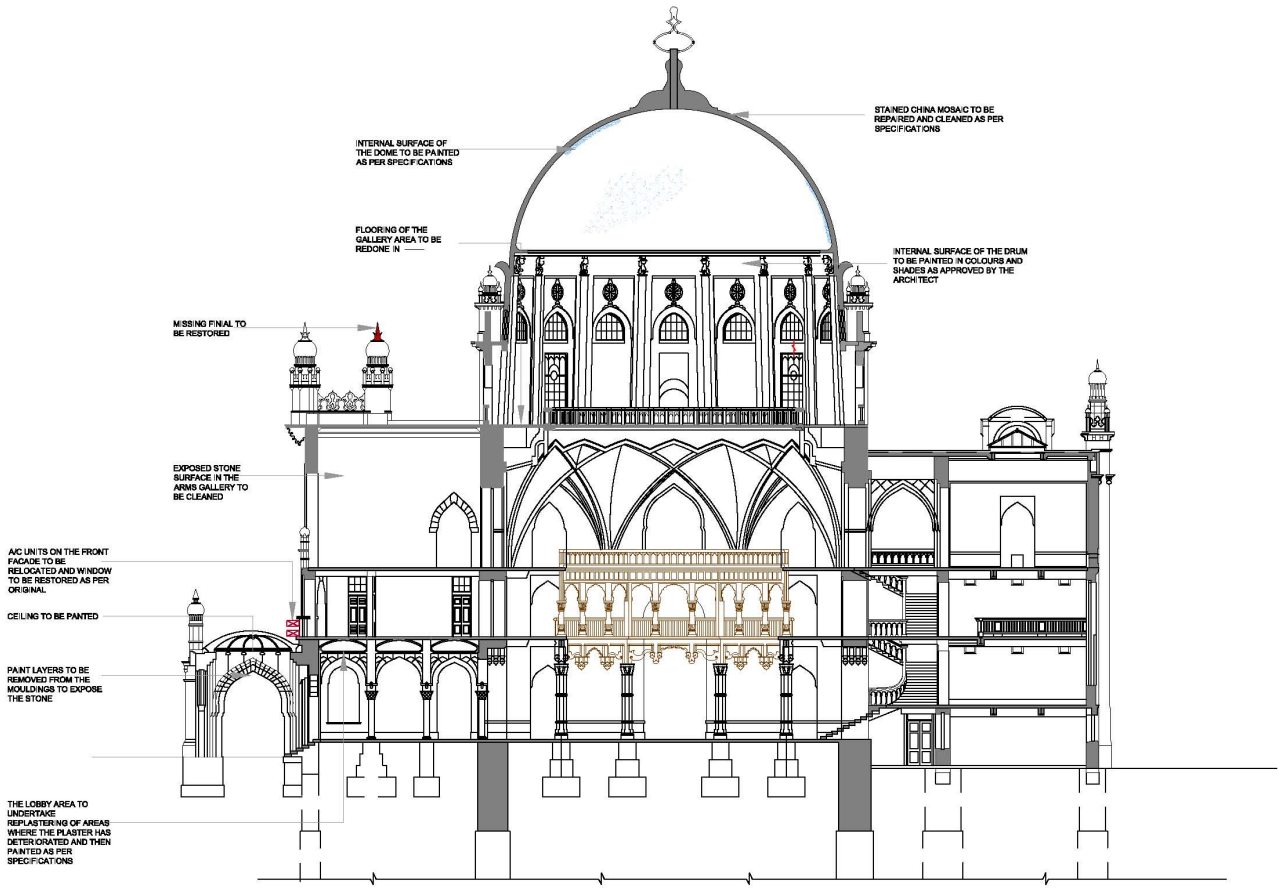

LEGEND

- Ribbon pointing - To be removed and repointing in lime
- Cement pointing - To be remvoved carefuly and repointing in lime
- Missing / Broken Details - To be restored
- Blocked openings - To be restored
- Damaged / Chipped stone - to be restored
- A C units - to be relocated
- Ficus / Vegetation growth - to be removed
- PVC/ Aluminium pipes
- Staining - to be cleaned

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CROSS SECTION

scale 1 : 250

DRG. NO. 8

BASE DRAWINGS PRODUCED WITH THE KIND PERMISSION OF RAHUL MEHROTRA ASSOCIATES

RESTORATION OF CHHATRAPATI SHIVAJI MAHARAJ VASTU SANGRAHALAYA

OPTIONS AVAILABLE TO ADDRESS THE PROBLEMS AND CHOICES MADE FROM THE AVAILABLE OPTIONS AND RATIONALE FOR THE CHOICES

The entire Restoration process was based on the philosophy of minimal intervention and authentic use of materials used for replacement and specialized skilled personnel on site to execute the works as outlined.

In case of the dome, the original surface of the dome did not have the china mosaic, however when the structural consolidation of the dome was carried out in 1990's, china mosaic was laid on the surface. While undertaking the Conservation of the Dome, two alternatives were available, of either removing the china mosaic and reverting to the original finish or allowing the existing china mosaic surface to be.

The proposal was discussed with Mumbai Heritage Conservation Committee and after much deliberation it was decided to retain the mosaic for two reasons.

1. It was feared that removal of mosaic might damage the historic fabric in the process which would have been more harmful to the integrity of the structure
2. For many years now, the City Museum with the China Mosaic Dome has formed a public imageability and therefore has become a part of the building fabric.

On both these counts, the principle of minimal intevention was followed.

SCOPE OF WORK

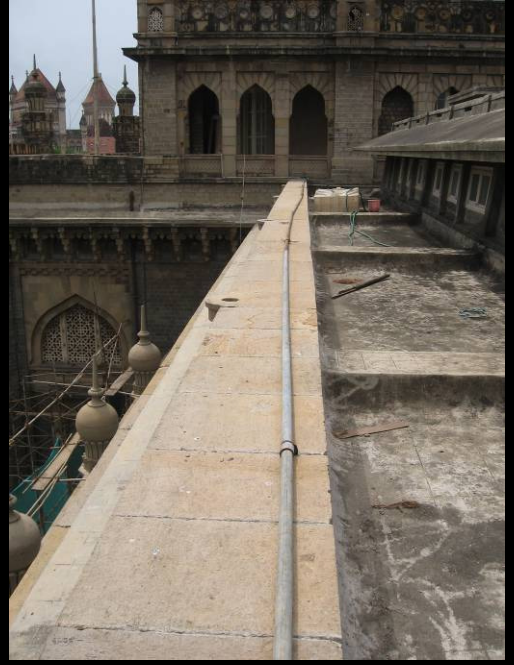
The Scope of Work included the following items:

- Stone cleaning
- Removal of hard Ribbon Pointing
- Repointing in lime mortar
- Chajja repair
- Grouting of the domes
- Cleaning of the domes
- Dutchman repair of Malad stone
- Plastic repair
- Plinth protection to arrest rising dampness
- Removal of ficus growth
- Terrace waterproofing
- Stitching of cracks
- Restoration of doors and windows

SEQUENCE OF ACTIVITIES AND USE OF SPECIAL TECHNIQUES

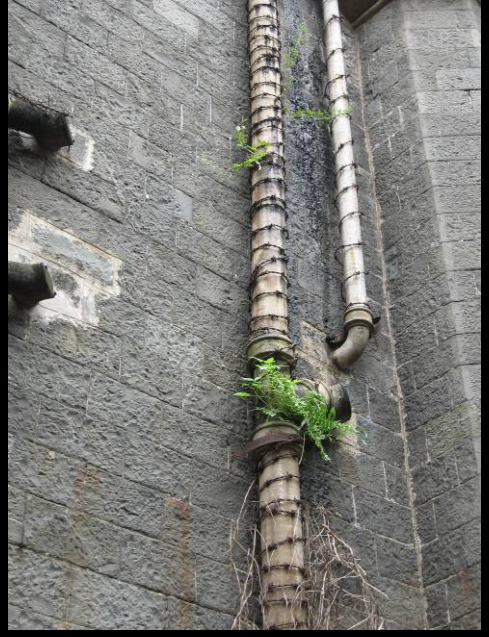
A steel scaffolding was erected on this section of the façade with adequate covering and ties. As part of the enabling works, the windows affected by the water misting works were protected and boarded up to prevent water ingress.

The original stone joints were very fine joints and ensured the breathability of the masonry, allowing trapped moisture to evaporate. Hard pointing in cement introduced at a later stage in the building, in fact competed with the strength of the stone masonry. As a result, it caused the moisture to evaporate from the stone surface, stressing the stone masonry and causing deposition of salts and consequently stone delamination. Removal of Hard pointing and re doing the same in fine lime pointing.



This pointing exercise was undertaken in the 1970's and the pointing mix was not compatible with the original softer lime pointing. Almost the entire façade of the North West and the south east protruding block has been re-pointed in cement. Ribbon pointing juts out from the surface of the masonry, is much wider than the original joint and different from the original texture of pointing, therefore altering the visual aesthetics of the stone. The careful removal of this hard ribbon pointing was undertaken as a first step in the restoration process.

REMOVAL OF HARD CEMENT POINTING AND REPOINTING IN LIME



Areas along rainwater down takes were prone to ficus growth as the constantly wet masonry harboured such plant growth. In the case of smaller ficus (peepal /banyan) plants growing out of the stone joints, the methodology adopted was that of pulling out the plant and using a syringe to inject the ammoniacal biocide into the root system. In case of larger plants, a length of the main stem was cut out at a convenient height above the stone surface. The plant was then sprayed over with biocides and the parent stem, after cutting was cut into a frill girdle, and coated with a paste made from Ammonium sulphamate crystals. This is a better system than using acids, but in cases of extremely stubborn growth, when the above measures are not effective, and the masonry is not a soft limestone, only then can the option of injecting acid be adopted, and that too after ensuring that no surface overflowing of the solution takes place.

REMOVAL OF FICUS GROWTH

The Structural Consultant Mr. Arup Sarbadhikary inspected the samples undertaken for chajja repair and recommended the procedure for undertaking polymer aided repair for the concrete chajjas. The spoiled cement was removed from the chajja's exposing the reinforcement which was treated by adding stirrups for support and strength. Anti corrosive paint was applied for protection. Then the chajja's were plastered with cement with proper admixtures.

The building has an external stone facing of grey Kurla Basalt stone, combined with buff coloured stone brackets and decorative bands in Malad stone that is a variety of trachyte. The masonry however, exhibits some amount of stone staining and stone surfaces on the external facades exhibit surface deposits, general staining and accretion of pollutants. The turrets and domes dotting the skyline were especially exposed to surface deposits and dark staining, while the patches of masonry near water spouts showed salt deposits and sulphate growth. Stone Cleaning with carefully calibrated water misting was employed and the sample areas were approved by the Architects.

The entire stone cleaning systems adopted have employed non abrasive, sensitive methods, without any use of harsh chemicals.

WATER MISTING AND SPECIALISED STONE CLEANING

Samples for cleaning the dome were made on the small dome. One sample was done as per specified in the BOQ, where the surface would get cleaned with the use of soft brushes and soft cloth to ensure no abrasion takes place on the surface of the china mosaic.

RESTORATION AND REPAIR OF THE SMALL DOMES

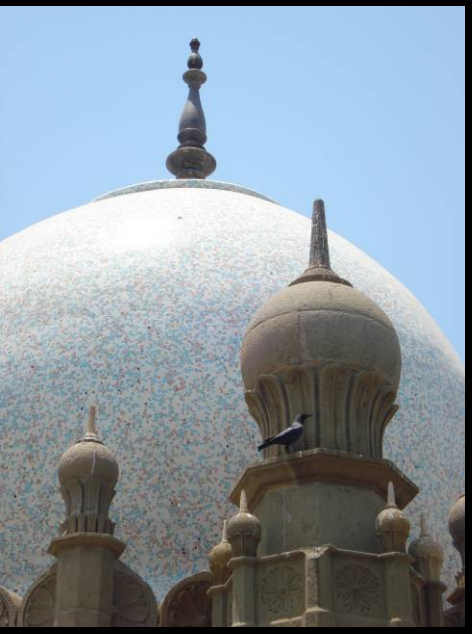
Joint meetings between the Architects, Structural Consultant, Project Management Consultants and Contractors have been undertaken to assess the quality and progress of work.

The Consultants have inspected sections of the terrace waterproofing that had been cracked and after opening out sections of hollow and cracked terrace waterproofing the team jointly decided that redoing the China Mosaic waterproofing would be a more effective treatment for addressing the waterproofing as the underlying layer of screed was very friable and had an extremely low cement content.

PERIODIC ASSESSMENT OF THE PROGRESS OF WORK

Stone sculptors have worked painstakingly over the carvings, matching the profile and sizes of the original pieces.

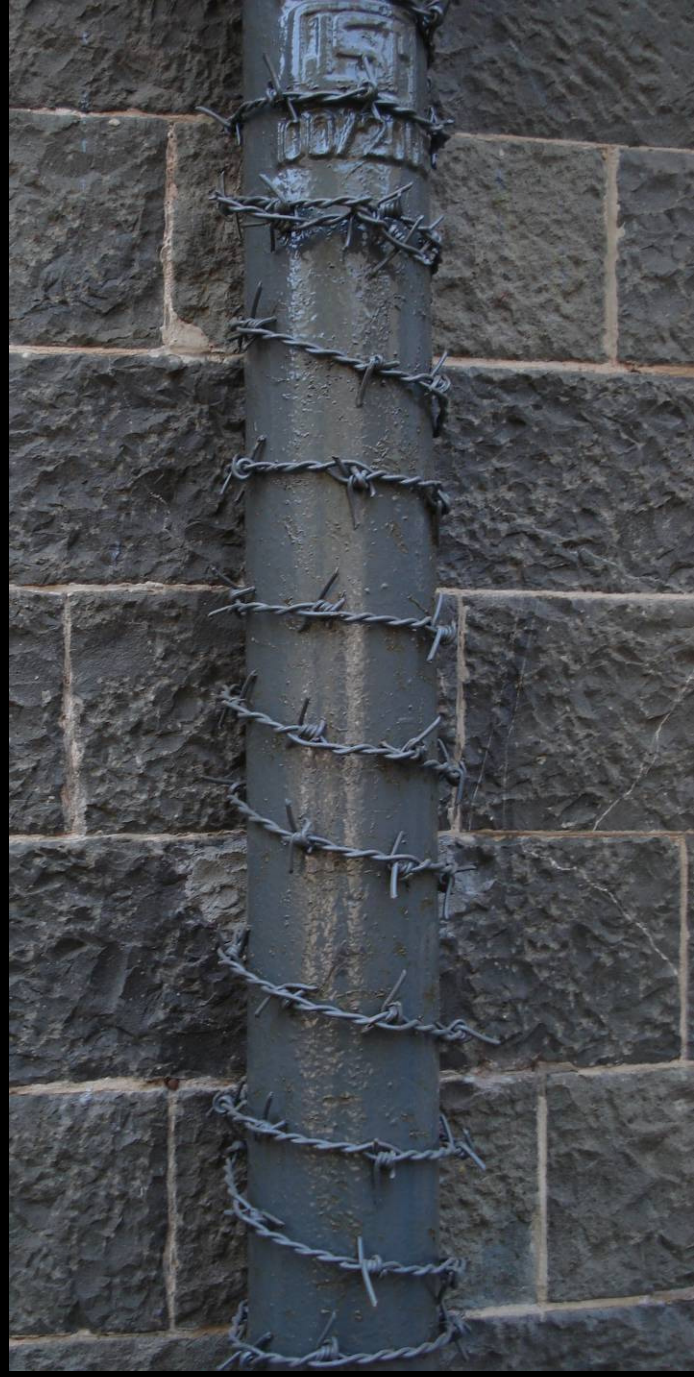
Various samples for Malad stone were shown and after having taken the approval from the architect, the contractors crafted new stone finials for Dutchman repair and fixed the new finials in position with non corrosive pins and dowels as seen in the photographs.



DUTCHMAN REPAIR AND REPLACING MISSING SECTIONS OF STONE GULDASTAS

The window restoration work included making of new shutters and frames where they were damaged beyond reasonable repair, restoration of window shutters and frames where they were damaged to a lesser extent and for those windows which were sound, only scraping of old paint layers and repainting.

The corroded cast iron pipes were removed and replaced by new cast iron pipes were with proper jointing and lead caulking to avoid any leakages through the joints. The existing pipes in a good condition were retained and were treated with anti corrosive layer and paint to match with the new.



To address the issue of rising dampness, earth was excavated at the periphery of the building for inspecting the condition of the stone and joints. The excavation was dug upto 1m and the crown of the arch could be seen of the foundation system. It was decided by the consultants to excavate upto 450mm and not disturb the foundation system. Thereafter all the opened joints were to be pointed in lime and cured for 7 days. The earth was then to be filled back into the pit.






Polymer Aided repair of the damaged and spalled concrete beams was undertaken under the supervision of Structural Rehab Advisor Mr. Arup Sarbadhikary.

INTERNAL POLYMER REPAIRS TO THE BEAMS

BEFORE RESTORATION

AFTER RESTORATION

BEFORE & AFTER RESTORATION

BEFORE RESTORATION

AFTER RESTORATION

BEFORE & AFTER RESTORATION


BEFORE RESTORATION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AFTER RESTORATION

SUMMARY OF COSTS

Actual Costs:

Description of Item	Amount
EXTERNAL RESTORATION WORKS	
ENABLING WORKS	12,33,553
RESTORATION WORKS	83,85,000
STRUCTURAL WORKS	8,00,000
RESTORATION OF DOORS AND WINDOWS	4,20,000
TERRACE WATERPROOFING	16,51,000
PLINTH PROTECTION	60,000
TOTAL	**1,25,49,553**
CONSULTANCY FEES @ 8.5 %	10,66,712
TOTAL FOR EXTERNAL RESTORATION WORKS	**1,36,16,265***

*** Note: 25 Lacs were sponsored by the MMRDA for External Restoration Works**

MAINTENANCE

Maintenance is the process by which the building is kept viable for the benefit of its users. Maintenance and preservation work is very skilled work and requires being valued as such.

Thus the care taking of buildings as in regular maintenance must be entrusted to skilled craftsmen and sensitive technicians.

Preventive maintenance should be part of planned strategic programme. As preventive maintenance protects the historic building without any intervention, it is highest form of conservation activity.

Maintenance should ideally be tackled by routines of daily, weekly, monthly, quarterly, semi-annual, annual and four yearly inspections, followed by reports.

A project has been developed, which outlines details of checklist points which need to be considered for the Maintenance of the Grade 1 Historic Building.